

*ENVIRONMENTAL ASSESSMENT  
OF THE  
OPERATION AND MAINTENANCE  
OF*

**LITTLEVILLE LAKE**

*MIDDLE BRANCH, WESTFIELD RIVER*

**HUNTINGTON AND CHESTER, MASSACHUSETTS**

*Prepared by*



DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS.

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## Preface

The purpose of this Environmental Assessment is to provide the basis for evaluation of the environmental impact on the project area due to the routine operation and maintenance of this flood control reservoir. Littleville Lake has been operated whenever necessary since it was constructed to prevent or reduce downstream flooding. Maintenance and management of the project, including the recreation facilities, during non-flood periods is also of primary importance. Enhancement of the fish and wildlife resources as well as protection of the environment within and around the reservoir area has been given careful consideration.

# TABLE OF CONTENTS

## Littleville Lake

	<u>Page</u>
I. PROJECT DESCRIPTION	1
A. INTRODUCTION	1
B. STRUCTURES AND RESERVOIR	2
C. OPERATION PROCEDURES	5
D. MANAGEMENT PROGRAMS	6
II. ENVIRONMENTAL SETTING	8
A. DESCRIPTION OF GENERAL AREA	8
III. ENVIRONMENTAL IMPACT OF THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM	15
A. OPERATION FOR AUTHORIZED PURPOSES	15
B. CONSTRUCTION AND MAINTENANCE OF PROJECT FACILITIES	28
C. MANAGEMENT OF PROJECT LANDS	31
IV. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED	36
A. FISH AND WILDLIFE - DOWNSTREAM CHANGES	36
B. WATER QUALITY - DOWNSTREAM RELEASES	38
C. FISH SPAWNING - WATER LEVEL FLUCTUATIONS AND DRAWDOWN	38
D. WILDLIFE HABITAT - PERIODIC INUNDATION	38
E. VEGETATIVE COVER AND TIMBER - PERIODIC INUNDATION	39
V. ALTERNATIVES TO THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM	39
A. DISCONTINUANCE OF AUTHORIZED PROJECT OPERATION	39
B. LAND AND WATER MANAGEMENT ALTERNATIVES	41
C. OTHER MANAGEMENT ALTERNATIVES	45
D. MAINTENANCE ALTERNATIVES	46
E. SEASONAL WATER LEVEL MANAGEMENT	48

VI.	THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY	50
A.	INTRODUCTION	50
B.	SOCIO-ECONOMIC BENEFITS	51
C.	BIOLOGICAL COMMUNITIES AND ECOSYSTEMS	53
VII.	ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH ARE INVOLVED IN THE OPERATION AND MAINTENANCE PROGRAM	54
A.	LOSS OF NATURAL RESOURCES DUE TO PERIODIC FLOODING	54
VIII.	COORDINATION WITH OTHER AGENCIES	54

## I. PROJECT DESCRIPTION

### A. INTRODUCTION

#### 1. Location and Authorization

Littleville Lake is maintained and operated by the New England Division, U. S. Army Corps of Engineers. It is located on the Middle Branch of the Westfield River within the towns of Huntington and Chester, Massachusetts. These towns are in Hampshire and Hampden Counties, respectively at the westerly side of the Connecticut River basin. The dam site is about one mile upstream of the confluence of the Middle Branch and the Westfield Rivers.

The project was authorized by the Flood Control Act of 3 July 1958 (Public Law No. 85-500, 85th Congress) in accordance with recommendations set forth in Senate Document No. 17, 85th Congress. Inclusion of provisions for future water supply in the Littleville flood control reservoir was authorized under the Water Supply Act of 1958 (Public Law 85-500). Construction of the dam was initiated in June 1962 and completed in September 1965, at a cost of \$6,882,000, including approximately \$2,000,000 to be paid by the City of Springfield for water supply features.

## 2. Purposes

### a. Flood Control

The dam is operated in close coordination with Knightville Dam on the main branch of the Westfield River, effecting reductions in flood damages at Westfield, Massachusetts as well as reducing Westfield River contributions to Connecticut River flood stages.

### b. Water Supply

A contract between the United States Government and the City of Springfield, Mass., dated December 13, 1967, gives the city the right to utilize water stored in Littleville Lake between the elevations 518.0 feet and 432.0 feet, mean sea level, for water supply purposes. Payments for the use of the water and storage are specified over a thirty-year period beginning when the first water supply diversion takes place.

## B. STRUCTURES AND RESERVOIR

### 1. Dam

Littleville Dam is a rolled earth and rockfill embankment, 1,360 feet long with a maximum height of 164 feet above the bed of the Middle Branch. A 935-foot long dike with maximum height of 46 feet is located on a natural saddle between a plateau containing the spillway and the eastern ridge. The top of the dam and dike is at elevation 596 feet, mean sea level (msl). Width at the top of the dam is 25 feet where an 18-ft. wide paved access road is also located.

## 2. Spillway

The spillway consists of a 7-foot high concrete ogee weir located on a bedrock plateau on the left bank, and a chute type spillway in a bedrock cut. The weir has a length of 400 feet with crest elevation at 576 feet, mean sea level. The discharge channel width varies from 400 feet at the foot of the curved weir to 50 feet at a distance of 440 feet downstream. The total length of the excavated spillway channel is 1,250 feet.

## 3. Outlet Works

The Littleville project has two separate reservoir outlet works, one for diversion of water supply, and the other for flood control.

### a. Water Supply Outlet Works

The main components of the water supply outlet works are: a 17.5-foot wide intake channel with invert at elevation 432 feet msl; an intake structure consisting of a wet well tower with four 36-inch diameter sluice gates at different elevations (447.0, 466.0, 485.0 and 504.0 feet msl) so that water can be drawn from various levels of the reservoir; an operating house on top of the tower; an outlet conduit; and a 20-foot wide outlet channel. The outlet conduit consists of a 9-foot wide arch-shaped conduit 800 feet long with a 48-inch diameter concrete water supply conduit installed within the arch, to be utilized when water supply operations begin (possibly around 1980).

#### b. Flood Control Outlet Works

The flood control outlet works consist of an intake channel, gates, tower and an outlet tunnel. The intake channel is 20-feet wide, excavated in rock to elevation 515 feet msl. Near the intake structure the channel widens to 30-feet to accommodate a 30-foot concrete weir with a crest elevation of 518 feet msl, the elevation of the maximum water supply pool.

From the weir a concrete-lined channel extends 88.5 feet to the gate structure. Flows are regulated by two 4 x 8-foot sluice gates, and from the gate structure flows are conducted to the outlet in a 370-foot long, 8-foot diameter concrete-lined "horseshoe" tunnel.

#### 4. Reservoir

Littleville Lake at spillway crest elevation 576.0 feet msl has a total storage capacity of 32,400 acre-feet, of which 9,400 acre-feet is reserved for water supply (below elevation 518.0 feet msl) and 23,000 acre-feet for flood control. The flood control storage is equivalent to 8.2 inches of runoff from the drainage area of 52 square miles. When filled to spillway crest, the reservoir will extend upstream along the Middle Branch for a distance of approximately 3.7 miles and have a surface area of 510 acres.

The maximum water supply pool covers 275 acres at elevation 518.0 feet msl, providing a reservoir shoreline of over five miles in length. This is the average pool elevation during most of the year.

Because of water supply considerations, the pool area was completely cleared of vegetation and topsoil, leaving a sand and gravel bottom.

#### C. OPERATION PROCEDURES

The operation of Littleville Dam is governed by conditions in both the Westfield River and the Connecticut River, as indicated by precipitation reports and river stages at index points in the river basin. During normal periods, the flood gates are maintained at three-foot openings. If ice build-up in the gate structure presents a problem, flood gates are closed sufficiently to maintain the pool at elevations between 520-522 feet msl.

All reservoir operations are preceded by communications with, and instructions from the Corps' Reservoir Control Center (RCC). The project manager will make an "alerting report" to the RCC when any of the following conditions occur: 1) one inch of precipitation during a 24-hour period at any station within the Westfield River network; 2) a rising stage of 522 feet msl is reached at Littleville; 3) a stage of 3.8 feet is reached at the USGS gaging stations on the West Branch of the Westfield River; and 4) a stage of 8.0 feet is reached at Westfield.

### 1. Flood Regulations

During the course of a flood, regulation of flow from Littleville Lake may be considered in three phases: Phase I, the storm and runoff appraisal leading to the initial regulation during development of a flood; Phase II, regulation during the flood period; and Phase III, emptying the reservoir following the downstream recession of the flood.

## D. MANAGEMENT PROGRAMS

### 1. Recreation

The lake is restricted with respect to recreational opportunities due to its future use for water supply, but does provide an excellent fishery. The City of Springfield Water Commissioners have established a set of rules for fishing, but no hunting, on the project lands. The two access points, one at each end of the lake, are equipped with boat launching ramps. However, boats are restricted to those having motors with not more than ten (10) horsepower and a minimum length of twelve feet.

The lake and the Middle Branch of the Westfield River support prime trout fisheries, enhanced by the State Division of Fisheries and Game's varied stocking program. Angling pressure is heavy from the season's opening (third Saturday in April) through Memorial Day.

## 2. Forestry

The major value of the silvicultural resources is for cover, both to maintain desirable runoff characteristics for protection of the water supply and to present an attractive natural setting for the project. The woodlands are principally of second growth mixed conifers and hardwoods of limited merchantable value. Limited management is conducted by the Littleville project manager, but much of the area is left in its natural state.

## 3. Fish and Wildlife

No hunting is allowed on the Government-owned lands surrounding the dam and reservoir. Although whitetail deer, cottontail rabbits and ruffed grouse are common in the surrounding hills and valleys, much of the adjacent privately owned land has been posted.

The Massachusetts Division of Fisheries and Game under lease from the Corps administers the trout stocking program in the reservoir and the river above and below the impoundment. Brook, brown and rainbow trout have all been stocked, with rainbows usually in the greatest quantities. The fish are introduced annually, often at several different times throughout the year.

Although hunting is prohibited on the project land, the Division of Fisheries and Game's nearby Chester Wildlife Management Area offers opportunities for hunting. The area is located between Knightville and Littleville Reservoirs and contains about 1,000 acres of land in a natural environmental setting.

## II. ENVIRONMENTAL SETTING

### A. DESCRIPTION OF GENERAL AREA

#### 1. Climate and Precipitation

The climate of the Westfield River basin is variable, due primarily to the large differences in elevation. While the lower basin is relatively mild, the rougher topography and higher elevations at the headwaters of the tributaries experience a more severe climate.

Storms over the watershed area are of four general types: (1) extratropical continental storms which move across the basin under the influence of the prevailing westerly winds, (2) extratropical maritime storms which originate over the ocean and move northward along the eastern coast of the United States, (3) storms of tropical origin, sometimes of hurricane magnitude and intensity, and (4) thunderstorms produced by local convective action or by more general frontal movements. Historically tropical storms have been the most severe and have occurred during late summer and early autumn.

The mean annual temperature in the basin ranges from about 44°F. in the mountainous regions to about 50°F. in the lower valleys. Extremes of 102°F. and -30°F. have been recorded in the lower elevations and the headwaters, respectively. The average January temperature in the vicinity of the project is 24°F., while the average July temperature is about 70°F.

Precipitation is evenly distributed among the seasons and averages about 46 inches at nearby Chester, Massachusetts. Snowfall varies widely over the basin, with an average depth of about 53 inches at Chester (elevation 600 feet msl) and over 70 inches at Chesterfield (1,425 feet msl) and Peru (1,860 feet msl). Average annual runoff for the Westfield River near Westfield, Massachusetts (period of record through 1961) has varied from 45.30 inches in 1955 to 14.82 inches in 1941 with a mean of 26.12 inches.

The U. S. Weather Bureau River Forecast Center at Windsor Locks, Connecticut, periodically receives precipitation reports from weather bureau stations in the Westfield River basin which are transmitted to the Corps' Reservoir Regulation Section. Those closest to Littleville are at Knightville Dam and the town of Chester. Precipitation is also measured at Littleville Reservoir. The Weather Bureau has a greater network of rainfall and river reporting stations in the Connecticut and Westfield River basins than in any other watershed of comparable size.

## 2. Topography

The study area is characterized by rough and rocky hills with steep slopes, separated by narrow valleys drained by many small streams.

Elevations within the immediate vicinity of the reservoir range from 432 feet msl at the dam site to 1,296 feet msl at the top of Goss Hill about 2.3 miles north of the dam. The Westfield River watershed has an approximate length, north to south, of 48 miles, an average width of about 11 miles and total drainage area of 517 square miles. The watershed elevations vary from 2,505 feet msl in the headwaters to about 40 feet msl at the River's confluence with the Connecticut River. The Middle Branch of the Westfield falls 1,100 feet over its length of 16 miles at an average gradient of nearly 70 feet per stream mile.

### 3. Vegetative Cover

About 90% of the reservoir area is wooded with a mixture of hardwood and softwood species: American beech, yellow birch, red and sugar maple, eastern hemlock, white pine and red pine. Seedlings of Norway spruce, white pine and red pine have been planted in an open field area east of Goss Hill Road and northeast of the dam.

Natural regeneration is occurring near the east reservoir shore in a clearing where a farmhouse formerly stood. Typical pioneer growths of gray and paper birches and some white pines are developing on the site, which is relatively inaccessible for maintenance by the project manager.

The far north end of the reservoir around the Dayville Access Area and the former East River Road supports a few acres of perennial grasses. Arrangements have sometimes been made for a local farmer to mow the high grass.

#### 4. Fish and Wildlife Species Present

Brown and rainbow trout are stocked annually in the lake, while brook trout are stocked in the Middle Branch of the Westfield River above and below the reservoir.

During pool filling in 1965 the lake was chemically reclaimed by the Massachusetts Division of Fisheries and Game to eliminate undesirable fish species. This also would increase the chances for survival and growth of the newly stocked trout because more food is available for the young due to reduced competition and also predation is reduced. Littleville Lake was withdrawn from reclamation status in 1971, thus allowing the fishing season to extend to February. Despite the 1965 reclamation, warm water fish have reappeared in the lake. Species include brown bullhead, yellow perch, pumpkinseed, largemouth bass and white sucker. Natural reproduction of trout is severely limited in the presence of these other fish because the fry now have such strong competition for food. Because the lake is thermally stratified what food exists is not available in the hypolimnion where the trout remain. In this man-made reservoir there is a lack of suitable forage species in the lower strata to constitute a good food supply for the trout.

Whitetail deer have also been seen at the reservoir area, but hunting on government land is not allowed by the City of Springfield. Most of the adjacent land is private and has been posted to prohibit hunting. Some hunting does, however, continue.

#### 5. Geological Features

The valley bottom beneath the reservoir consists of light yellowish-brown sand, gravel and boulders, probably deposited during the late Pleistocene Age and early Holocene Age by glacial melt-water streams. Thickness of the terraces varies from 10 feet to 30 feet.

Gravel resources in the Chester area are limited. Most of what does exist lies beneath farmlands, residential settlements and the reservoir's stream terrace deposits. It is thus not practicably recoverable. Other mineral resources of possible economic value are talc and emery, which were mined for a brief period around 1910. Veins of white quartz are common in the area and have been prospected in the past. The quartz is of a quality considered to be suitable for crushing and subsequent use in the production of exposed aggregate for ornamental building facing.

## 6. Socio-Economic Conditions

The immediate area of the Littleville Lake is characterized as rural and sparsely populated. Population figures for Huntington and Chester are:

	<u>1960</u>	<u>1970</u>
Huntington	1,391	1,593
Chester	1,155	1,025

However, the project lies within the highly-populated Northeast Region and is accessible over several excellent Interstate routes and well-kept rural roads into the project area. According to the 1960 U. S. census report over 1.3 million persons reside within 40 miles of the Reservoir. The urbanized City of Westfield, which the project is designed to protect, was settled in 1660 and has a present population of 31,433. There is a great deal of residential development in this area, while commercial and industrial developments have continued to locate on the flood plains between the Westfield and Little Rivers where they are seriously threatened by flooding. More than half of the many industrial firms in the City of Westfield are susceptible to flooding.

In recent years the immediate vicinity of the project has experienced an increase in summer residences and recreational use, with access to the many parks and state forests in the region. Recreation service industries have consequently grown. The surrounding towns have small industry related to the area's emery deposits, but this activity has declined.

However, taking into consideration the entire Westfield River basin, manufacturing does play a major role in the economy, with most of the diverse activity concentrated in the urban communities of Westfield and West Springfield. These also contain most of the intensely cultivated land in the basin, being on rich valley lowlands.

Agricultural development has generally become unimportant to the area in economic terms. Shade-grown tobacco is now the principal crop, and is produced nearby on large farms around the mouth of the Little River below Littleville Lake.

Extensive recreational facilities are located close to Littleville Dam. These include, for example: the Chester Wildlife Management Area, between the Knightville and Littleville projects; Norwich Pond in Huntington; the Charles M. Gardner State Park on the East Branch of the Westfield River; and the Grace A. Robinson Wildlife Sanctuary, the Westfield Sportsmen's Club and Stanley Park, all in the City of Westfield. Many other recreational opportunities exist throughout the Connecticut River basin, the Lower Pioneer Valley Region and the Mount Holyoke Range and Mount Tom chain. The Littleville project itself with its prime fishing opportunities is readily accessible by Interstate Routes 90 and 91.

There are no known historical or archaeological features located near enough to be affected by the project.

### III. ENVIRONMENTAL IMPACT OF THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

#### A. OPERATION FOR AUTHORIZED PURPOSES

##### 1. Downstream Effects - Regulation of Flows and Releases

##### a. Flooding Prevented

The flood pool stage at Littleville Lake has equalled or exceeded elevation 527.0 feet msl (12 percent of the flood control storage capacity) 8 times since the dam's completion in 1965.

With a recurrence of the Westfield River basin flood of record in August 1955, (peak natural flow of 81,000 cfs at Westfield, Massachusetts) the reservoir would prevent \$4.3 million in damages after reductions by the Knightville project. Primary flood control benefits accrue to the City of Westfield through protection of residences, commercial establishments and public buildings situated in the Westfield River flood plain.

In April 1969, Knightville and Littleville Reservoirs were filled to 38% and 33% of capacity, respectively. This combined storage created a reduction of seven feet in the Westfield River stage at Westfield, and represented the maximum utilization of flood control storage at Littleville Lake to date.

Despite a long history of flooding in the City of Westfield, development is still taking place in flood-prone areas. Over 3,100 acres in the City are subject to flooding by the Standard Project Flood (SPF)<sup>1</sup> after reductions by Littleville and Knightville Reservoirs. This area, mostly in the lowland between the Westfield and Little Rivers, contains almost 2,000 residential properties, 260 commercial businesses, 30 public buildings and 27 industries.

We cannot quantify the degree to which continued flood plain development is attributable to the flood protection afforded by Littleville Dam. However, while the Dam has and will prevent much financial loss due to flooding, we must warn that the flood risk has not and probably never will be reduced to zero. Flood control projects are designed only to prevent some frequency of flooding that is economically justifiable relative to the costs of the project. At present, some flood damage still occurs in this area on an average of once every two years. Therefore, the economic benefits of flood plain utilization must be weighed against the potential losses to the natural, social and economic environment in case of major flood and during flood control operations.

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<sup>1</sup>The Standard Project Flood for the Westfield River was developed from standard project storm rainfall, as described in Civil Engineer Bulletin No. 52-8 and unit hydrographs derived from analyzing recorded floods in the Westfield River basin. It is defined as the largest flood that can be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geological region involved.

b. Fish and Wildlife

The Middle Branch of the Westfield River has particularly good conditions for several species of fish and the Littleville Dam is operated to preserve these conditions. However, the project's operation is also constrained by the need to protect the water quality of this future source of water supply.

Due to the area's inhospitable topography, wildlife habitat is somewhat limited. The Middle Branch falls 1,100 feet in its 16-mile length, or an average of nearly 70 feet per stream mile. Because of this steep gradient and the rapid evacuation of the Littleville Lake following recession of downstream flood peaks, the modified spring flood discharges have had velocities high enough to flush out silt and sediments in the mile of stream below the dam. Nevertheless, there appears to be little scouring effect. Furthermore, being reasonably confined within its channel, the stream has not picked up excessive soil and litter from areas adjacent to the banks, resulting in an unusually clear, clean stream.

The effects of Littleville flood control operations have been to delay spring flood peaks for perhaps two or three days and to reduce rather than eliminate the high flood peaks, thus preserving the beneficial effects of natural flushing.

During spring flood periods, the operation of Littleville Dam to a degree benefits the downstream trout fishery by reducing the suspended solids load. In addition, dam operation maintains sufficient flow to wash the gravel and rock stream bed.

c. Vegetative Cover and Timber

Littleville Lake has not been in operation long enough to effect major changes in downstream vegetative patterns. From the dam to the confluence with the main stem Westfield River, the Middle Branch is situated in a narrow, steeply sloped and wooded valley with few flat or low-lying areas. Very little of the valley, therefore, is subject to extended flooding because the river stage rises and falls quickly. The major beneficial effects are derived from the Reservoir's reduction of Westfield River flood flows and subsequent protection to low-lying communities on the main stem, the City of Westfield, particularly.

More significant adverse effects on vegetation may be an indirect result of Littleville flood protection. As discussed previously, one effect of flood control operations has been encroachment onto the flood plain in the City of Westfield, although local flood plain zoning may be forthcoming. The present construction of buildings and paving of parking lots in this area destroys flood plain vegetation, which is both a vital part of the riverine ecosystem (as food for animals) as well as natural protection of the soil from erosion. Such development also destroys the river's natural flood storage which should be supplemental to, but not replaced by flood control reservoirs.

In a comparatively small watershed, such as the Westfield River basin, overdevelopment of flood-prone lowlands can cause more harm to the area's ecosystem than is caused by certain detrimental flood control operations. For example, while normal spring freshet flows may be reduced by some 50 or 60%, this applies to runoff from the reservoir - controlled drainage areas. The combined drainage area above Knightville and Littleville Dams represents only about 40 percent of the Westfield River basin drainage area at the river's mouth. This factor somewhat diminishes the effect that the dam's reduction of spring flows will have on the area's biota. On the other hand, major environmental benefits are achieved through reduction of the major floods of late summer or early fall. Of significance here are those floods that occur rather infrequently, usually the result of tropical storms or hurricanes. Their mitigation by flood control reservoirs causes less environmental disturbance as well as fewer losses of life and property than would occur naturally. While biota of a watershed have adjusted to annual spring flooding, a summer storm of large magnitude produces extraordinary conditions not so easily tolerated by the plant and animal species present.

#### d. Water Quality

The Middle Branch of the Westfield River has been designated a Class A stream from its source to Littleville Dam and Class B below the dam. The Massachusetts Division of Water Pollution Control describes each water use classification as follows:

Class A - Waters designated for use as public water supplies in accordance with Chapter III of the Massachusetts General Laws. Character uniformly excellent.

Class B - Suitable for bathing and recreational purposes including water contact sports. Acceptable for public water supply with appropriate treatment. Suitable for agricultural, and certain industrial cooling and process uses; excellent fish and wildlife habitat; excellent aesthetic value.

The high quality streams which feed the reservoir originate in the unpopulated watershed areas above the dam. Thus there is little or no degradation of the streams' water quality other than by natural geographic conditions.

During a flood control operation, the Littleville project manager is required to release a minimum flow to sustain downstream fishlife. A minimum discharge will also be maintained during future reservoir diversion when the City of Springfield begins supplementing its Cobble Mountain Reservoir water supply. During flood periods, full or partial restriction of flows through Littleville Dam has in the past been followed by the release of substantial discharges of stored flood waters after a storm has abated.

The critical water quality period is during the late summer months when natural discharges are lowest, rather than in the spring when the water temperature is low and flows are high. The overflow weir at elevation 518.0 feet msl normally discharges water from the surface of Littleville Lake such that the outflow is equal to the inflow. Comparison of discharge water

quality data with inflow water quality data shows minor influences from impoundment. Thermal and chemical stratification are characteristic of the reservoir during the warm months of the year; therefore, the warmer water moves through the upper layers of the reservoir only. For this reason and because the surface area of the reservoir is large and warmed by exposure to the sun, the temperature of the discharge is sometimes 3-4<sup>o</sup>F. greater than inflow temperature. A slight decrease in dissolved oxygen is evident, but other parameters show no significant degradation due to impoundment and release procedures.

e. Recreational Use and Aesthetics

The Westfield River White Water Canoe Club has held canoe races on the Westfield River since 1954. The Club recently requested flow regulation at Knightville Dam to provide optimum conditions for the races. Such regulation of this reservoir for the races is impractical. However, the natural spring discharges over the weir contribute to flows in the Westfield River, therefore moderating the amount of regulation needed at Knightville Dam.

For the major part of each year, flows into and out of Littleville Lake are the same. In time of flooding, Littleville moderates peak flows but does not appreciably alter the rising and falling pattern of the natural flood, except by delaying it for a short period. This method of operation has not significantly changed the flow regimen of the Middle Branch and consequently there is little adverse visual or aesthetic impact.

## 2. Upstream Effects in Reservoir

### a. Fish and Wildlife

The size and depth of Littleville Lake (normal surface area of 275 acres and depth of 86 feet at the dam) provide a variety of temperature and water quality conditions for the resident trout populations. The trout habitat, therefore, has been only slightly upset by the storage of flood waters during spring runoff. The Massachusetts Division of Fisheries and Game has conducted creel census for the 1968 to 1971 fishing seasons. A comparison of these data with the annual stocking figures of the state indicates a fairly good year-to-year holdover of trout in the reservoir. Further support for this fact comes from a fish sample taken between October 27 and October 31, 1969 by the Division of Fisheries and Game. Although no large rainbow trout turned up in the sample of 307, a number of brown trout ranging in length from 12.5 to 17 inches were found, with two fish measuring 19 and 21.5 inches. And, indeed, the extrapolated 1971 creel census showed that the fishermen harvested rainbow trout in numbers well exceeding the year's stocking.

The present aim of the Division of Fisheries and Game seems to be to establish a "trophy brown trout fishery" in the permanent trout waters of the hypolimnion. In 1965, following construction of the dam, the lake was chemically reclaimed in order to reduce competition for the newly stocked game species and allow them to get a foothold in the new environment. The recent reappearance of brown bullheads, white suckers, and yellow perch will most likely result in a decrease in the growth rate of the trout if, in fact, their populations are not limited. The standard

procedure of periodically rejuvenating reclaimed trout waters by repeating the process every 5 to 10 years may not be attractive to the Division due to the large size of the conservation pool. Another deterrent is the reservoir's potential withdrawal as fishable water when the regulations of a municipal water supply are imposed, despite the fact that many experienced, enlightened municipal water departments have permitted even fuller recreational use without detrimental effect (See Section V. B. 3.).

It can, however, be anticipated that as the non-game fish populations increase, the hold-over brown trout fishery will decline. At this point the State will begin to consider it a "put and take" fishery and place more of its stocking effort in rainbow trout. This will concentrate the majority of the fishery into the first few days of the fishing season due to the susceptibility of rainbow trout to angling. The present brown trout-rainbow trout fishery is advantageously extended, brown trout being more difficult to catch and therefore maintaining fishable populations throughout the fishing season.

The wildlife aspects of the Littleville project area are limited, but were slightly affected by construction of the project. In their letter report on the then-proposed Littleville Dam, the Bureau of Sport Fisheries and Wildlife stated that the permanent inundation of 275 acres was expected to cause insignificant losses of wildlife habitat. Relatively little land above the permanent pool elevation has been affected by flood control operations; that which has been flooded is mostly the steep, wooded hillsides which slope sharply to the water's edge. Almost all the area within the

maximum flow line of the reservoir is heavily forested, and the absence of large cleared and brushy areas has tended to limit the populations of small upland game animals. However, the impoundment does attract some migrating waterfowl.

The letter report assessed the pre-project resources, stating that hunting pressure for white-tailed deer was heavy. A few deer still range throughout the reservoir on the steep slopes which are not easily accessible to hunters. Most of the land surrounding the project is privately owned and posted, but 150 hunters have been reported in one year according to Corps of Engineers' visitation figures. Thus, some hunting opportunities have been sustained even though the rules and regulations set up by the City of Springfield state that hunting on project lands is officially prohibited.

In any case, because flooding of the project area has been of short duration, what wildlife does inhabit the area is only slightly affected. Few, if any, wildlife losses can be attributed directly to the operation of Littleville Reservoir for the authorized purpose of flood control.

b. Vegetative Cover and Timber

Along most of the reservoir shoreline, forest cover extends to within a few feet of the water's edge. Field observations indicate that the trees around the perimeter of the lake are in generally healthy condition. Several abandoned fields, on both the east and west sides of the reservoir, have begun to regenerate naturally, with white pine

seedlings abounding on the parcels. There are few depressions to hold standing water for extended periods. And since release of stored flood waters most often commences soon after the reservoir reaches maximum stage, adverse effects on plants and woody vegetation have been small.

c. Recreational Use

There are two designated shore fishing areas and two boat launching ramps at Littleville Lake. Access to these areas is prohibited at Reservoir flood stages to assure public safety. Because of future water supply considerations, no other permanent recreational facilities exist at the project which would be threatened by flood control operations. As such, these areas are characterized by a pleasantly natural environment.

d. Aesthetics

In general, the aesthetics of the relatively small project area are good. However, the Littleville project manager and personnel have spent as much as two weeks clearing away floating branches and logs caught at the log boom above the dam following recession of a flood. While this may be an unattractive result of a reservoir flood operation, two useful aesthetic purposes may be served: first, dead or fallen material which would ordinarily remain on the hillsides and upstream of the reservoir is carried down and manually removed at one time;

and second, the debris is prevented from passing downstream and obstructing the channel or being washed onto the streambanks which would thereby become unsightly. On the other hand, many may regard this fallen material as part of the necessary ecological recycling of biota as it decomposes and supplies nutrients to the soil and vegetation. The naturalist generally feels that such objects are a desirable and aesthetic aspect of the natural environment. Therefore, their removal due to flooding of the hills may be undesirable. But since a comparatively small area is inundated (in the past less than 100 acres), the aesthetic effects of flood control are not of critical concern at Littleville.

Because Littleville Lake is confined to a single, steep, narrow valley and stream channel, increases in the flood control storage capacity are derived mainly from increases in reservoir depth at rising river stages rather than an enlargement of the surface area flooded. The 510-acre pool at spillway crest has less than twice the surface area of the maximum water supply pool. Unlike other projects where an area two or three times as large as the permanent reservoir may be inundated, the environmental and aesthetic disruptions from less inundation are understandably less detrimental.

e. Beneficial Uses of Water

As previously discussed, Littleville Lake is a multi-purpose reservoir, designed to provide future water supply to the City of Springfield. The City does not plan to utilize Littleville water until its average daily use approaches the safe yield of its primary water supply, Cobble Mountain Reservoir. At the time of project completion, diversion was estimated to begin in 1968. However, in 1971 the average daily water use in Springfield was 39.31 million gallons per day (m.g.d.), while the safe yield of Cobble Mountain Reservoir is approximately 50 m.g.d. At such time as the City commences to divert water from Littleville to Cobble Mountain Reservoir, the magnitudes and kinds of resultant environmental impacts will depend on a number of yet-to-be defined factors. These will include the rate of diversion and thus the rate of pool drawdown, the times of year in which diversion will occur, the elevations to which the reservoir will be lowered and the frequencies of drawdown to various elevations. The City may use the maximum capacity of the pool from elevation 518.0 ft. msl to 432.0 ft. msl, but must maintain a reservoir discharge of 5 cfs.

On September 16, 1971, the City of Springfield Municipal Water Works requested permission from the Corps of Engineers to allow the Western Massachusetts Electric Company to use water stored at Littleville for hydroelectric power generation. The company would use the City's pumping station and pipelines from Littleville Lake to Cobble Mountain

Reservoir to supplement storage at Cobble Mountain, thus providing excess water for power generation. The lack of data on the timing and rates of diversion precludes the possibility of accurately predicting the environmental impacts of any removals of water from Littleville. A number of agencies are in the process of reviewing the City of Springfield's request and it is likely that a separate environmental impact statement will be prepared specifically for the proposed diversion for power generation. The New England Division, Corps of Engineers, has tentatively approved the proposed use with a number of conditions to protect the trout pond and stream and preserve the aesthetics of the area, but final approval must come from the Secretary of the Army. At present Springfield has not responded to the recommended modifications and other Federal and State agencies have grave reservations about the proposed diversion. (See Section V. D. for details of the Corps' recommendations.)

## B. CONSTRUCTION AND MAINTENANCE OF PROJECT FACILITIES

### 1. Recreational Facilities

Physical improvements for recreation at Littleville Lake have been minimal primarily because of the regulations imposed by the City of Springfield on its water supply. The Huntington Access Area, located at the lower end of the reservoir, has a boat launching ramp and parking lot large enough for 20 cars, plus 38 cars with trailers. A distance of about 2,800 feet above the boat ramp has been designated a shore fishing area. Rest rooms are available in the utility building between the dike

and the flood control outlet of the dam. In general, the Littleville project manager is well situated to oversee the Huntington area and to conduct routine maintenance at the facilities.

The Dayville Access Area, at the north end of the reservoir (see Plate 2), has a parking lot with capacity for 40 cars and 38 cars with trailers. A boat launching ramp is also located there. Over a mile of lake shore and stream bank fishing on the western side of the reservoir is available from Dayville. Maintenance requirements are minimal. A local farmer has sometimes been contracted to mow a few acres of meadow grasses adjacent to the parking lot in order to relieve the Littleville project manager of added maintenance.

Fishermen are the primary users of both access areas; however, the continued enjoyment of fishing at Littleville Lake will depend in part on the eventual restrictions imposed on use of the lake when it is finally utilized for water supply. The project manager has encountered no public abuse of facilities which would necessitate significant maintenance programs and continued recreation use would appear to present no problems for the water supply.

As mentioned earlier, the lake has been chemically reclaimed by the State in order to improve the trout fishery. This control practice eliminated other species which would compete with trout for available food. However, these other species have again appeared (see Section III. A. 2. a.) and could necessitate a repeat of the treatment if the reservoir is not to be used as water supply for another five or more years. Other treatments might also be considered.

## 2. Sewage and Solid Waste Disposal

The only permanent public sanitary facilities at Littleville Lake are in the utility building near the dam. A comfort station was constructed and subsequently removed from the Dayville Access Area, being within the flood pool and subject to inundation, with the consequent threat of pollution to the water supply from sewage. Four temporary chemical toilets are provided during the fishing season for public use. Two of these are located at each access area.

Users of the reservoir are expected to dispose of solid wastes properly, either in trash receptacles on reservoir lands or by removing refuse from the project area. There are no significant adverse effects to report, as negligent littering has not been prevalent at Littleville.

### 3. Insect and Vegetation Control

The preservation of Littleville as a natural environment and the lack of intensive recreational development have eliminated the need for all but the most rudimentary controls. Insects are no more than normal summer pests, and safeguarding the water supply is reason enough to forego the use of harmful chemicals at Littleville.

The high quality water, cold temperatures and the dearth of extensive shallow areas have naturally limited the growth of aquatic weeds. No problem is foreseen for many years.

The shore fishing areas are kept accessible by trimming and thinning of brush as required, but the remainder of the project has been relatively untouched. The minor adverse environmental effects of the occasional brush trimming at fishing areas here are outweighed by the recreational benefits accruing to the large number of fishermen using the reservoir annually.

### C. MANAGEMENT OF PROJECT LANDS

#### 1. Rules and Regulations

The Board of Water Commissioners, City of Springfield, Massachusetts has adopted a number of rules and regulations relative to fishing use of Littleville Lake. The primary objective of the rules is to ensure the safety and enjoyment of all visitors while protecting the future use of Littleville for municipal water supply. They are essentially similar to those for Quabbin Reservoir which supplies water to the City of Boston.

The restrictions on use, partly aimed at preserving the natural aesthetic quality of the area, have foreclosed some recreational benefits and opportunities.

The report on Littleville's fish and wildlife resources submitted by the Bureau of Sport Fisheries and Wildlife recommended that the reservoir be available for public hunting and fishing. The Bureau also shared the opinion with the Massachusetts Division of Fisheries and Game that hunting and fishing on watersheds are compatible with protection of domestic water supplies. Nevertheless, regulations have since disallowed hunting at Littleville. The loss is not of major proportions in light of the area's past hunting pressure but does signify the removal of a large tract of potential public hunting land. At a time when more and more private land is being posted, and public access for hunting is in demand, this limitation may become significant.

## 2. Fish and Wildlife Management

The chemical reclamation of Littleville Lake in 1965 was accomplished by the Massachusetts Division of Fisheries and Game using rotenone to remove the warm water species in preparation for trout stocking. The emuliffied rotenone used acts as a capillary constrictor, killing fish by interfering with oxygen intake through the gills. The substance oxidizes rather quickly, usually after a week or so, and therefore the duration of its toxic effect

is brief. Since the operation was done while the pool was at a low level and subsequently filled, the overall adverse effect was small. Littleville Lake has since been managed as a trout pond through an annual stocking program.

As part of the trout management activities, the Division of Fisheries and Game carried out detailed creel census at Littleville Lake beginning in September of 1968 and continuing through the 1971 fishing season. Fish populations were also sampled in October, 1969, using gill and fyke nets.

The Division's expanded creel census data indicate that 13,222 anglers fished at Littleville in the 1969 season, 13,000 in 1970 and 11,495 in 1971. Detailed interviews during the first two weeks of the 1971 season also revealed that most anglers came from Springfield, Westfield, West Springfield, Chicopee or Holyoke, while fishermen living in the adjacent towns of Huntington and Chester seldom use the facilities.

The future availability of Littleville Lake for fishing is important to residents of Springfield and other urbanized communities in the lower Connecticut River valley. Congamond Lake, on the Massachusetts-Connecticut border near Southwick, Massachusetts, and Russell Pond about two miles south of Russell, Massachusetts, are the only other managed trout ponds, comparable to Littleville, within short driving distance of the Springfield metropolitan area. Both of these receive heavy fishing pressure at present.

In late October 1969 the Division of Fisheries and Game collected a fish sample from Littleville which verified that the lake was becoming recontaminated with the same species that comprised the pre-reclamation population, namely, white suckers, brown bullhead, yellow perch, golden shiners, common shiners, fallfish and one creek chub. The 1971 census also indicated catches of largemouth bass and pumpkinseed. At times, these fish compete with trout for available food and space and yet they do not constitute a food source for the trout for much of the year when the lake is thermally stratified, because trout cannot tolerate the higher water temperatures in the epilimnion.

Studies have shown that a maximum of five to seven years' effectiveness can be expected from chemical reclamation. Subsequent reclamations by chemical means may be undesirable, from the viewpoint of the City of Springfield if the lake is to be used for water supply before 1978. If a long-term trout fishery is planned, treatment of the entire lake would not be desirable, since reclamation is non-selective. The warm-water fish present will thus probably prevent the Littleville trout fishery from becoming more than a put-and-take proposition unless a suitable hypolimnion forage species for the trout is introduced.

Nevertheless, the presence of some larger brown trout in the fish sample does suggest a potential for establishing and holding trophy-sized trout in Littleville Lake. To this end, perhaps, the Division of Fisheries and Game has decided upon a stocking composition of one-third brown trout and two-thirds rainbow trout with an average of 6,000 trout introduced each year. Brown trout have typically proven more difficult to catch than rainbows and therefore are usually sought by the more serious anglers.

Trout management of Littleville Lake has provided both shoreline and boat fishing for a large number of fishermen, although fishing pressure has been lower than the predicted potential of the pool. No adverse impacts on water quality as a result of fishing have been documented at Littleville Lake or indeed at very many other reservoirs currently being used for both water supply and recreation. A sustained trout fishery represents significant benefits for anglers and recreation seekers.

There is no formal wildlife management at Littleville Lake as the project is closed to hunting due to its potential use for water supply. The Massachusetts Fish and Game Department, however, stocked 33 Canadian Geese in 1973 in anticipation of establishing new breeding grounds in the western part of the State.

### 3. Pollution Control

The rules and regulations governing the use of Littleville Lake in effect limit the number of potential pollution sources by restricting recreation activities. The major portion of the watershed area above the dam is sparsely populated, and the main influence on inflowing water quality comes from the natural geographic conditions of the upper basin. The prompt removal of floating debris after flood control operations assures that the material does not contribute significantly to the organic load in the reservoir. Because practically all of the project lands are forested and because no formal wildlife management occurs, no fertilizers are used on government-owned land where they might enter the reservoir via surface runoff or groundwater. The forest cover also maintains the quality of the watershed, thereby protecting the water quality of the reservoir.

#### IV. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

##### A. FISH AND WILDLIFE - DOWNSTREAM CHANGES.

Annual spring discharges of the Middle Branch of the Westfield River are delayed and reduced by Littleville Dam to the extent necessary for downstream flood protection. The effects are cumulative as one proceeds downstream. The Middle Branch naturally receives the greatest of the modification attributable to the dam, then the Westfield River, when Knightville and Littleville combine to alter its natural flow, and finally the Connecticut River where several dozen dams artificially impound and release its waters. The protection of economic development on the flood plain by flood control dams has some serious ecological implications and unavoidable effects on fish and wildlife, on both a local and a basinwide scale.

Locally, the attempts to confine the Middle Branch and the main stem Westfield River to their channels limit the productivity of flood plain areas. These areas, normally flooded in the spring, nurture diverse plant and animal life as part of the food chain. Trout and other fish feed on insect larvae and adult flies. Therefore, a decrease in their breeding areas on the flood plain adversely affects the food supply for fish as well as many species of birds. However, the area immediately downstream of Littleville Dam slopes steeply to the river and contains little or no flood plain lowlands. Such wetlands are found slightly further on the main Westfield River and particularly near the City of Westfield. Reservoir flood control operations will here contribute to the adverse effects of reduced lowland flooding, but that is the price Westfield area business have evidently decided to pay for protection of flood plain development. Furthermore, additional impacts on riparian vegetation

and small animals from flood regulation as well as riverway development are magnified because the entire food chain is affected.

Regionally, the Connecticut River is potentially important as an anadromous fishing resource. Detailed investigations of shad, blue herring and alewives are beginning to shed light on the spawning behavior of these fish. River flow is one environmental factor which has a vital influence on the species. Studies have shown that the fish usually start to move up the Connecticut after the river has crested and has begun to recede in the spring. Secondary river rises are often the result of the rapid evacuation of tributary flood control reservoirs, such as Littleville. The normal activity of these fish can be interrupted by the irregular flow patterns of the river.

During all non-flood periods, the weir overflow at Littleville Lake insures that discharges are very nearly equal to inflows. However, when the City of Springfield diverts water from Littleville Lake to Cobble Mountain Reservoir, the situation could change drastically. Springfield has full rights to the entire storage of Littleville Lake below elevation 518 ft. msl with the single requirement that a minimum flow of 5 cfs be maintained during diversion. If such diversion and minimum discharge were to occur for an extended period in the late spring or early summer, the quality of the downstream trout fishing would be severely impaired, since flows are usually much in excess of 5 cfs during the peak trout fishing season. Although the requirements for minimum release, allowable rates of drawdown and other factors, are presently being discussed for another purpose (see Section III. A. 2. e.), the designated minimum flow requirement could be ecologically disastrous if imposed during diversions under the adverse conditions described above.

#### B. WATER QUALITY - DOWNSTREAM RELEASES

When the surface water of Littleville Lake becomes heated in the summer, the temperature of the outflow is oftentimes a few degrees warmer than that of the corresponding inflow. This effect could be avoided by discharging cooler water from one of the lower water supply gates. However, such a regulation procedure should not be initiated until additional information is available regarding dissolved oxygen concentration vs. depth in the lake in order to avoid withdrawing water with low D.O. Water quality is not a significant problem at Littleville Lake.

#### C. FISH SPAWNING - WATER LEVEL FLUCTUATIONS AND DRAWDOWN

Flood control operations at Littleville Lake may adversely affect the spawning of warm water fish in the reservoir. However, this may be advantageous for trout management efforts if reproduction and populations of competing species are reduced. It is doubtful that trout are affected since they swim upstream to spawn either in the spring (rainbow trout) or in the fall (brown trout).

#### D. WILDLIFE HABITAT - PERIODIC INUNDATION

Between 50 and 100 acres of potential wildlife habitat are subjected to temporary annual inundation. This land, however, lies in a rather narrow band around the edge of the reservoir. The better wildlife habitat, in terms of utilization by a number of different species, was lost initially when the reservoir was established. At the time, this was a significant loss because the narrow stream valley represented possibly the best habitat. With respect to the effects of a continuing operation program, a major flood which fills or almost fills the reservoir will cause relatively greater losses of wildlife habitat and the effects

will be noticeable for a longer period of time.

#### E. VEGETATIVE COVER AND TIMBER - PERIODIC INUNDATION

The trees and other vegetation growing close to the reservoir will undoubtedly suffer progressively from the effects of periodic flooding. They may also become more susceptible to insects and disease, if not killed outright by inundation. As evidenced by the characteristics of natural reforestation occurring in the reservoir's lower open fields, it is most probable that vigorous understory growth will be sufficient to replace larger trees as they die. The adverse effects of flooding on vegetation are unavoidable at the Littleville project but they are also minimized because of the natural sloping terrain of the reservoir.

#### V. ALTERNATIVES TO THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

##### A'. DISCONTINUANCE OF AUTHORIZED PROJECT OPERATION

###### 1. Flood Control.

Littleville Lake is an essential part of the Westfield River flood control system. Even with the Knightville and Littleville projects in full operation, there exists a need for further flood plain protection in the City of Westfield because of the continuing development. The authorization for a Corps of Engineers local protection project for the City expired in September 1969, after the required local cooperation was not assured. The Connecticut River Basin Coordinating Committee recommended that the project be reauthorized and constructed.

In view of this evident inadequacy of existing flood protection, the alternative to discontinue Littleville's flood control operations is unjustifiable and would necessitate some other additional remedial structural measures.

## 2. Water Supply.

The negotiated water supply contract between the United States Government and the City of Springfield, Massachusetts at present forecloses the alternative to eliminate water supply as an authorized project purpose unless Government authorization were given. Moreover, Littleville Dam was especially designed to accommodate water supply with a significant capital investment above that needed for flood control. Throughout the northeast region domestic water supplies are in such great demand that to discontinue this purpose would be to waste a valuable resource. On the other hand, the present and contemplated restrictions on recreational use imposed by the City of Springfield constitute a severe limitation on public enjoyment of the fishing and recreation opportunities (See Section B. 3. below). Many other municipal supplies presently in use are also utilized for multiple non-conflicting recreational purposes, with no detrimental effect on water quality. Temporary discontinuance of Littleville Lake as a water supply in favor of full or slightly limited public use would probably have little effect on its later conversion to a municipal water supply. Even if minor treatment were necessary, the present benefits would be of great value.

## B. LAND AND WATER MANAGEMENT ALTERNATIVES

### 1. Discontinuance of Land Management Activities.

The trout stocking program of the Division of Fisheries and Game and the regulations adopted by the Springfield Board of Water Commissioners comprise the only established management program at the Littleville project. The City of Springfield suspended fishing privileges in its Ludlow Reservoir in 1959 and in Cobble Mountain Reservoir (to which Littleville Lake water will eventually be diverted) in 1962. Therefore, the possibility exists that Littleville Lake will be closed to fishing when the City begins active use of the water supply. Naturally fishery management would cease as well.

Published research and professional opinions indicate varying water quality effects from limited recreation at water supply reservoirs. Elsewhere water supplies have been used even for water-contact sports with no serious results. The potential public abuses of any recreational privilege such as fishing constitute probably the most significant threat to water quality, especially when close surveillance is not conducted.

Yet to use this reason as justification for discontinuing public use is to severely penalize the majority of those who are responsible in their recreation activities. In defense of the City of Springfield it should be noted that the decision to discontinue fishing at Ludlow Reservoir was understandably based on the prime reason that large expenditures would be necessary to adequately supervise fishermen and other users.

A 1965 study examined the effect of suspending fishing privileges on the water quality of two of Springfield's water supply reservoirs. The study concluded that water supplies should be used only for that purpose at all times. However, it appears that the analysis was based on measurement of only total coliform density, being conducted before adequate methods for measuring bacterial and viral-pathogen content were available. While coliform may be a prime indicator for quality of drinking water, there are other reasons, to be discussed below, why recreation use would not be incompatible with water supply.

Elimination of fishing and fishery management at Littleville would represent the loss of important recreational and environmental values but would be implemented if there were no other alternative for protecting water quality and public health. However, whether such potential elimination or the present regulations do substantially protect public health has been heatedly debated and should be re-evaluated. Without fishing, there would be practically no public use of the Government-owned project lands, an undesirable situation at a time when multiple use of public property is being heavily stressed.

## 2. Single Purpose Management.

Littleville Lake is a designated multiple-purpose reservoir to be used for both flood control and water supply. The only other formal management program is for fishing, with additional uses excluded to safeguard the water supply. Continued fishery management and avoidance of further recreational development would probably be sufficient to limit over-use of the project as well as retain the relatively natural environmental setting. The project is in any event not well suited for large scale picnicking or camping due to the lack of suitable topography.

### 3. Multiple Purpose Management.

Except for fishing, Littleville Lake offers few management prospects. Thinning and forest improvement measures would be exceptionally difficult on the wooded steep valley slopes and disturbance of the forest cover could produce runoff characteristics detrimental to the reservoir water quality. The terrain is not suited to intensive wildlife management, in addition to the fact that hunting is presently not allowed.

Littleville Lake is available for hiking, snowmobiling and other recreational activities. The project manager has posted regulatory signs for snowmobiling, requiring one foot of ice cover on the lake before the vehicles may be used. The State of Massachusetts requires at least four inches of snow cover on the ground.

A management program aimed at encouraging, rather than just permitting, those forms of recreation requiring no permanent facilities would lead to better overall utilization of the project's natural resources without placing undue strain on environmental quality. An interpretive program, related to the fish and wildlife in the area, could be instituted, as well as an expansion of the information given the visiting public about the site, its development, management, purposes and benefits. Such information can lead to better public understanding and enhanced appreciation of a flood control-water supply project and, hence, to greater public responsibility at these sites.

As discussed previously, the opportunities for multiple recreational use of Littleville Lake should not be overlooked. The concerns of the Springfield Water Board for protecting their water supply are understandable, especially in view of the experience with two of their other reservoirs. However, the growing popularity of Littleville as a prime trout lake, one of the very few accessible to the Springfield Metropolitan area, should justify a re-evaluation of the 1965 study conclusions. Since the City's own residents will benefit from the expanded recreational opportunity, the Board might consider the costs of added maintenance and possible increased treatment in light of its public's needs and desires for water-based recreation. The Connecticut River Basin Study has described in adequate detail the pros and cons of recreational use of water supply sources. However, with respect to the question of cost, it should be noted that multiple use contributes substantially to lower costs for the provision of both recreation and water supply. The City might consider sharing the costs (and benefits) of recreation management with other municipalities in the reservoir area or the Springfield area.

A national survey conducted by the Sport Fishing Institute "revealed that over 90% of all municipal reservoirs reported had been opened to public fishing before 1960, and that water supply resources are not only ideally suited in many cases to meet public needs, but can be managed for multi-use without dangerous deterioration of the water quality required for suitable levels of potability and health." With modern water analysis and purification techniques available, the "traditionally rigorous isolation of water supplies (is) much less valid."

All this may be premature if, when the water supply is actively utilized, fishing is allowed to continue and if the Corps' Master Plan for recreational development is implemented. The major facilities from this 1966 plan which have not been constructed are the picnic area and the group camping site at the Dayville Access Area. These were to be very small but were not developed because of fear of public abuse of the water supply. At Littleville the present exclusion of hunting is significant in an area where much of the land is privately owned and posted. This prohibition should be reviewed as should the entire question of multi-purpose management so that maximum public benefit will be derived.

#### C. OTHER MANAGEMENT ALTERNATIVES.

Despite the continuing threat of flood and the impracticability of total structural flood control, some new construction continues in the flood plain at Westfield. Further encroachment may be viewed as an indirect and partial result of flood protection afforded by the operation of Littleville Lake. The Corps of Engineers, in its General Design Memorandum for the proposed Westfield Local Protection Project, attributed a minor percentage of the annual benefits quantified (about 9% or \$23,000) to the possible increased utilization of undeveloped flood plain lands. This would indicate that flood plain development should not be a major justification for flood control projects.

Therefore, the potential for building in these lowlands resulting from the

presence of dams and reservoirs and unnatural river channels and dikes, must be overruled by farsighted non-structural management of the flood plain. To prevent continuing damage and irreversible impacts on riverine ecology, measures must be investigated such as flood plain zoning or other regulation, acquisition of flood hazard areas and removal of flood-threatened structures from the riverway. These will hopefully offer management tools by which the mutually supportive relationship between flood protection and flood plain development can be overcome and the adverse effects minimized.

#### D. MAINTENANCE ALTERNATIVES

Because there is little public use other than fishing at Littleville Lake, the need for maintenance of the lands is minor. Maintenance of the fishery requires the most concentrated activity and is conducted by the Massachusetts Division of Fisheries and Game. The major problem presently, barring total closure of the reservoir to fishing, is maintaining good cold water sport fishing in the Lake. Littleville Lake and the Middle Branch of the Westfield River have the potential to support naturally reproducing trout populations as well as large-size brown and rainbow trout. The potential is being diminished, however, by two critical, related biological factors: (1) the recurring abundance of warm water species which overly compete with trout for available food, and (2) the lack of a suitable cold water forage species which would provide food for the trout all year long.

In most reclaimed ponds and lakes, rotenone treatment must be repeated every five to seven years for continued effectiveness. Rotenone has been applied in streams feeding other water supply reservoirs and used also to eliminate fish from water supply reservoirs. It is possible that Littleville Lake could be reclaimed with rotenone again prior to its use for water supply, since the substance breaks down

rapidly and no chronic effects have been documented, the effects usually wearing off after a week to a month. The greatest adverse effect of reclaiming Littleville Lake would be the possible loss of trout which have been able to grow and reproduce, since the chemical does not discriminate among species. Whether Littleville Lake could safely be reclaimed after water supply diversions begin is controversial, with scientific evidence and public opinion differing widely.

The Division of Fisheries and Game has considered the alternative of controlling at least white sucker populations using nets and traps in the Middle Branch of the Westfield River during the spring spawning run. This method could retard the populations if the fish were caught before eggs were deposited and fertilized and might be a worthwhile experiment. Other methods such as electric shock or exploding depth charges could also be investigated.

The second difficulty for trout growth and reproduction is the absence of an adequate food source. Since Littleville is a man-made lake imposed on a stream, there is no natural hypolimnion forage species available. At Quabbin Reservoir, the Massachusetts Division of Fisheries and Game has introduced smelt to aid the trout fishery. Now, however, the smelt have become so abundant that they inhibit water flow through the water supply intake and pipes. Similar problems could occur if the species were introduced at Littleville and trout populations could not check their proliferation. Too many times the introduction of non-native species of any kind has caused tremendous problems in the long run. Therefore any substitute should be approached cautiously with full regard for the ecological implications.

## E. SEASONAL WATER LEVEL MANAGEMENT

One of the environmental assets of Littleville Lake is the reasonably stable water level which has been maintained during non-flood periods of the year. Because an incremental change in storage capacity is accompanied by a comparatively large change in reservoir depth, low flow regulation or other seasonal water level management, requiring a small increment or flow is not practicable at Littleville. The overflow weir at elevation 518 feet msl and the outlet works have not been designed to regulate the small changes required during low flow periods. The Littleville project manager would have to reset the gates very frequently if July and August low flows were to be augmented by the project.

Although the weir overflow has not been designed to facilitate the regulation of small discharges, one other alternative should be examined. The Springfield Water Department constructed a small operating house in 1968 housing one 12" gate valve and one 24" gate valve. The 12" gate valve will be regulated to maintain a minimum release during future water supply diversions and when the lake falls below elevation 518.10 feet msl. As Littleville Lake becomes thermally stratified in the summer, water could be drawn through this lower gate to reduce downstream river temperatures considerably and improve trout fishing throughout the summer months. The Bureau of Sport Fisheries and Wildlife included this recommendation in its pre-project conservation and development report. The only critical factor which would require study is the dissolved oxygen concentrations at this level and the rate of reaeration downstream. It might well be that the cooler water could become oxygenated in a fairly short distance downstream of the dam to produce positive benefits for fishing. This alternative could be studied operationally on an experimental basis to determine the thermal and water quality inter-relationships and their effect on the stream fishery. Actual implementation

of this alternative will depend on obtaining concurrence from the City of Springfield who has operational control of releases from the water supply outlet works.

When the City of Springfield diverts water from Littleville, the water level regulation aspect will become increasingly important. In response to the City's request for leasing water diversion facilities to Western Massachusetts Electric Company, the Corps' Division Counsel recommended acceptance (with final determination to be made by the Secretary of the Army) under the following limitations:

- a. In general, the period of diversion from storage should be between 15 October and 1 March.
- b. There will be no diversion after 1 March until the pool fills to elevation 518 feet msl. The pool will then be maintained at 518 feet msl, until 15 October, except for flood control impoundments. During the period 1 March to 15 October, surplus inflows (inflows greater than that required to maintain the pool at elevation 518 feet msl) can be diverted.
- c. A minimum downstream release of 10 cfs will be maintained whenever diversion or storage is taking place.

These proposed restrictions would help preserve the aesthetics of the Littleville project and reduce the undesirable effects of drawdown on the lake fishery.

However, the basic contract agreement between the Corps and the City of Springfield contains no specific restrictions concerning rates and amounts of drawdown.

In either case, therefore, some guidelines ought to be imposed such that the reservoir is maintained at suitable depths to sustain populations of fish and aquatic organisms at all times. To date no action has been taken concerning the City's request to lease facilities to Western Massachusetts Electric Company.

## VI. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

### A. INTRODUCTION

Most flood control projects have been developed in response to an immediately perceived need, that of protecting valuable land uses from harmful flooding. Usually the response has occurred after some critically damaging flood, which made the need appear more urgent at the time. In these cases, hindsight tells us exactly where flood control is necessary and to what extent. What it does not tell us is that our vision may be obscured by that immediate need such that we only see the disastrous results of our problem, but fail to see the potential effects of its solution. With respect to some of the projects that attempt to control nature, experience has shown us that such artificial manipulation, without sufficient long-term planning, can have serious adverse effects. Not only are future options foreclosed on use of the land, but alteration of the ecosystem may become so final and lasting that unforeseen influences result in secondary, even more widespread impacts. Or, for example, flood control benefits derived initially may, in the future, no longer be necessary when such methods as strict land use regulation are instituted, the consequence being a tragic waste of resources.

The immediate benefits are flood prevention, and the effects are excellent on long-term economic development, as well as for maintenance of present levels of productivity. However, both positive and negative impacts must be weighed in not only quantitative, but also qualitative terms, so that our decisions will be justifiable in generations to come.

## B. SOCIO-ECONOMIC BENEFITS

### 1. Flood Control Benefits

The area which the Littleville Dam is intended to protect is highly developed and industrialized. The greatest concentration of residential, commercial and industrial developments are located on the lowlands in the City of Westfield, approximately twelve miles below the dam. During the flood of September 1938, the flood of record on the Middle Branch and the upper Westfield Rivers, 78 percent of the peak discharge (55,500 cfs) was produced by the tributary areas above the Town of Huntington, which is equivalent to 65 percent of the watershed above Westfield. Littleville controls one of these tributary areas. The flood of record for the entire basin occurred in August 1955, when it is estimated that Littleville Reservoir would have prevented \$4.3 million worth of damages. Had the reservoir been in operation with Knightville Dam, no flooding would have occurred behind the dike above the southern portion of Westfield. Thus, the impetus for construction of Littleville is clearly perceived.

The necessity for the project lies in the natural behavior of the Westfield River Basin, which has a relatively high flood potential throughout the year because of its rapid runoff characteristics. The magnitude of the manufacturing carried on in Westfield and West Springfield is dependent on the flood protection afforded by the dams and reservoirs in the basin. Agriculture, primarily tobacco production, is also important in these two cities and is also benefitted by the mitigation of flood flows. In addition, residential and commercial development has continued in the flood plain below Littleville. While this development has serious implications for the flood plain ecosystem (discussed in Section C.1, below) the continuation of the

Westfield area as a center for industry and manufacturing is substantially beneficial to long-term human economic productivity.

## 2. Recreational Benefits

Within easy driving distance of the Springfield metropolitan area, Littleville Lake is one of a very few trout ponds. While the stream probably supported a trout fishery prior to the project, and was stocked by the state, the popularity of an accessible, well-managed cold-water pond is unquestionable. Fishing pressure on lakes managed for trout is usually more than three times the pressure on warm-water ponds. Estimates of the number of anglers indicate that more than 13,000 have utilized the project resources in one year. In addition, interviews revealed that most of the fishermen do come from the Springfield area. Thus, the Littleville Lake is an invaluable public resource whose use is destined to increase if allowed to do so. However, there is a possibility that the City of Springfield may prohibit fishing when it begins to utilize the reservoir as a supplemental water supply. The elimination of this unique sport fishery would have significant adverse effects on long-term recreational opportunities for the very citizens of Springfield who own the rights to the municipal water supply.

## 3. Water Supply Benefits

As a multiple-purpose reservoir, the Littleville project is designed to be utilized for a supplemental municipal water supply by the City of Springfield. In the northeast, as in other parts of the country, usable water resources are becoming more scarce. It is widely recognized among planners, as well as municipal, state and Federal agencies that reservoir sites must be preserved. Too often they have been subject to encroachment and intense development pressure for other uses incompatible with water supply. In New England, leisure home building and the rapid growth of winter sports have exerted a major influence

on land use, aggravating the economic problem of acquiring and preserving reservoir sites in a tight land market. Springfield will probably not begin using this water supply until 1980, but its inclusion as part of a Federal flood-control project ensures its long-term preservation.

## C. BIOLOGICAL COMMUNITIES AND ECOSYSTEMS

### 1. Changes in Land Use

The flood protection provided downstream communities on the Westfield River has unfortunately encouraged urban and suburban development in the very flood plain which is being protected. While residential structures and industrial buildings must be protected for the sake of the regions long-term economic productivity, the flood plain must also be preserved. Littleville Lake controls roughly an area of only about 10 percent of the Westfield River Basin drainage area. Thus, whether continued development in the flood hazard zone can be attributed to the Littleville project is difficult to justify, but there is no question that the project, as part of the comprehensive system of flood control, contributes to the public's security which in turn leads to the general feeling that flood plain development is safe and harmless to all. Yet when these ecologically productive wetlands are eliminated, fish and wildlife are threatened, in addition to the loss of natural flood protection. Runoff will increase and erosion may begin and the flood control structures may no longer be able to provide the protection for which they were designed.

### 2. Modification of Stream Flows

Modified spring flood discharges from Littleville have not been significantly lower than would naturally occur, and so would have less effect on the fish downstream. The construction of the reservoir obviously eliminated the stream

fishery in the 2.5 miles of the Middle Branch which were inundated. In addition, the presence of the dam and reservoir probably limits the reach below the dam within which trout may move upstream to spawn. However, the long-term recreational benefits accruing from the creation of a prime trout pond outweigh these losses.

## VII. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH ARE INVOLVED IN THE OPERATION AND MAINTENANCE PROGRAM

### A. LOSS OF NATURAL RESOURCES DUE TO PERIODIC FLOODING

As stated above, creation of the Littleville Lake resulted in the permanent loss of 2.5 miles of the Middle Branch of the Westfield River. During storage of floodwaters, up to 0.9 additional miles are lost temporarily. Thus, the commitment of the stream fishery represents a significant loss, but one which is more than compensated for by the establishment of a trout fishery in the reservoir. In this steeply sloping area, loss of wildlife habitat is insignificant. Similarly, periodic inundation has had little effect on the forestry resources which appear to be in generally healthy condition and enhance the natural aesthetic quality of the project.

## VIII. COORDINATION WITH OTHER AGENCIES

Coordination with various Federal, State and Local interests resulted in valuable input to this assessment. Both meetings and correspondence proved to be very helpful. Following is a list of the several interests with whom coordination took place:

Bureau of Sport Fisheries and Wildlife

Soil Conservation Service

New England River Basins Commission

Massachusetts Division of Fisheries and Game

Massachusetts Audubon Society

City of Westfield, Massachusetts

City of Springfield, Massachusetts



